

## Impact of Covid-19 Pandemic Quarantine on Civil Engineers' Performance and Projects' Construction Delay

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**Abstract:** The COVID-19 pandemic quarantine affected several sectors and human activities, among them projects of construction and engineers' performance. This study aimed to investigate how civil engineers dealt with quarantine conditions during the COVID-19 pandemic and how it affected their work. The research was conducted in Sulaymaniyah City, Kurdistan Region, Iraq, via an online questionnaire for those who work at the site and offices. Data were collected in December 2020 from 150 engineers using Google Forms. Apart from demographics, questions were asked about the effect of COVID-19 on office engineers, the long-term implications of the COVID-19 pandemic on civil engineering and project construction, and construction delays. Results revealed that engineers working in the field had a greater ability to create social distance in their workplace. Moreover, compared to the government sector and office engineers, more field engineers working in the private sector believed that they might lose their jobs as a result of the COVID-19 pandemic. Furthermore, the COVID-19 pandemic totally influenced on project construction delays and civil engineers' performance. One-third of those interviewed think that "teleworking" can be completely replaced by working in an office or field.

**Keywords:** Civil Engineers, Construction, COVID-19, Lockdown, Projects, Sulaimaniyah

### 1. Introduction

Coronavirus disease, which is caused by severe acute respiratory syndrome, was first reported in Wuhan, China, in 2019 (Hui et al., 2020). The disease is contagious and has spread rapidly over the world, prompting the World Health Organization (WHO) to classify it as a pandemic (World Health Organization, 2020). Covid-19's spread poses an unprecedented threat with unforeseeable economic effects (McKibbin & Fernando, 2021). For the past 18 months and counting, the outbreak of an extraordinary pandemic, called COVID-19, has brought the entire world to a halt. The COVID-19 pandemic lockdown affected the environment, education, communication, sport, social activities, etc. (Aziz, 2020; Hussin & Aziz, 2021). This pandemic had an impact on both human health and the operations of businesses and organizations, including the construction industry as well (Ogunnusi et al., 2020).

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The COVID-19 pandemic has had far-reaching and extremely serious impacts since it has spread to all countries. The economy is already suffering from the COVID-19 outbreak. Many countries are experiencing a recession or economic slowdown. All corporate activities have been halted unless they fall into crucial categories such as essential supplies and medical sectors, as well as a few critical projects that are required to sustain the health system and people's safety. It has affected businesses globally, and organizations have turned to a Work-From-Home (WFH) model to accommodate and run their businesses and services remotely (Gamil & Alhagar, 2020).

With the coming of the COVID-19 pandemic, the message all over the world was clear: people should stay at home. Indeed, this caused dilemmas in all sectors, especially in the construction sector. The construction industry is far different from other industries, which typically require the on-site involvement of all the project members. Therefore, the situation for the construction industry was very critical. Workers, engineers, technicians, construction companies, and contractors lost their jobs due to the lack of funding (Gamil & Alhagar, 2020).

Several types of research have begun to look at the economic and industrial effects of COVID-19. Because of the existing state of uncertainty, the reviews are insufficient. One of these studies investigated the economic impact of the pandemic outbreak on the economies of 30 countries and estimated that Gross Domestic Product (GDP) is likely to be damaged by 3 to 6 % in some countries and might drop as low as 15% in others (Fernandes, 2020). Different research studies studied the influence of the outbreak on the supply chain and discovered that the industry has been significantly damaged, and that recovery may take longer (Ivanov, 2020). Harari (2020) investigated that the COVID-19 pandemic is the generation's worst crisis, one that will take years to recover from, and that decisive action must be taken to fund and plan new tactics to avert humanity's suffering. Helm's (2020) study pointed out that COVID-19's absolute lockdown has greatly harmed economic activity. The COVID-19 pandemic has had a significant impact on the construction sector in general.

Bsisi (2020) studied that the COVID-19 pandemic's lockdown has forced all civil engineering design offices and active construction projects to halt all onsite construction work and convert design engineers to work from home. The study revealed that designer civil engineers can operate from home with reasonable efficiency, but construction site civil engineers do not feel that after the lockdown is lifted, construction workers will stick to social distancing and wear needed personal protective equipment.

According to Gamil and Alhagar (2020), since the WHO labeled the coronavirus outbreak a pandemic, numerous countries have ordered a complete national lockdown due to a significant increase in COVID-19 cases. The construction sector, which has always been a major growth generator for the economy, has also been fully shut down. Until further notice, all developments and projects have been halted. Economic and human resource implications have been separated into separate sections. Exploratory interviews and questionnaire surveys are two strategies suggested by the study. The analysis discovered that COVID-19 had the most significant effects on project suspension, labor impact, job loss, time overrun, cost overrun, and financial consequences. According to this research, the findings provide light on the ramifications of a pandemic's abrupt emergence and raise awareness of the most significant effects that must not be overlooked. The findings also assist project stakeholders in understanding the sequences of the unexpected pandemic and preparing for the worst-case scenario during the construction project planning stage.

Shibani et al. (2020) undertook a study on the effects of pandemics on the United Kingdom (UK) construction sector; specifically, how project managers, contractors, engineers, and subcontractors responded to these pandemics. Site engineers, project managers, construction teams, subcontractors, and contractors were among the 30 people that participated in the study. According to the data, the COVID-19 pandemic had a significant impact on construction enterprises dealing with both residential and commercial development due to lockdown and social distancing on work sites. Construction companies' strategies included keeping good relationships with their suppliers and ensuring the safety of construction workers. The outcomes of the study will provide insight into how construction companies in the UK can deal with future pandemics to become more resilient.

In the Kurdistan Region of Iraq, COVID-19 impacted several sectors, one of them being the construction sector. In the Kurdistan Region (for instance, in Sulaimaniyah Province), engineers, workers, technicians, contractors, and construction companies were influenced by the COVID-19 pandemic lockdown. Consequently, this study aimed at the perception of engineers in the city of Sulaymaniyah, Kurdistan Region, Iraq, both those who work at the site and offices, about how they handled the situation during the lockdown and how the lockdown affected their work. Therefore, for this purpose, an online questionnaire was filled out and attended by approximately 150 engineers.

## 2. Methodology

### 2.1 Study Site

The research was conducted in the city of Sulaymaniyah (Figure 1). It is one of the largest cities in Kurdistan Regional Iraq, which is located in northeastern Iraq at 35° 33' 40"N and 45° 26' 14"E, respectively.

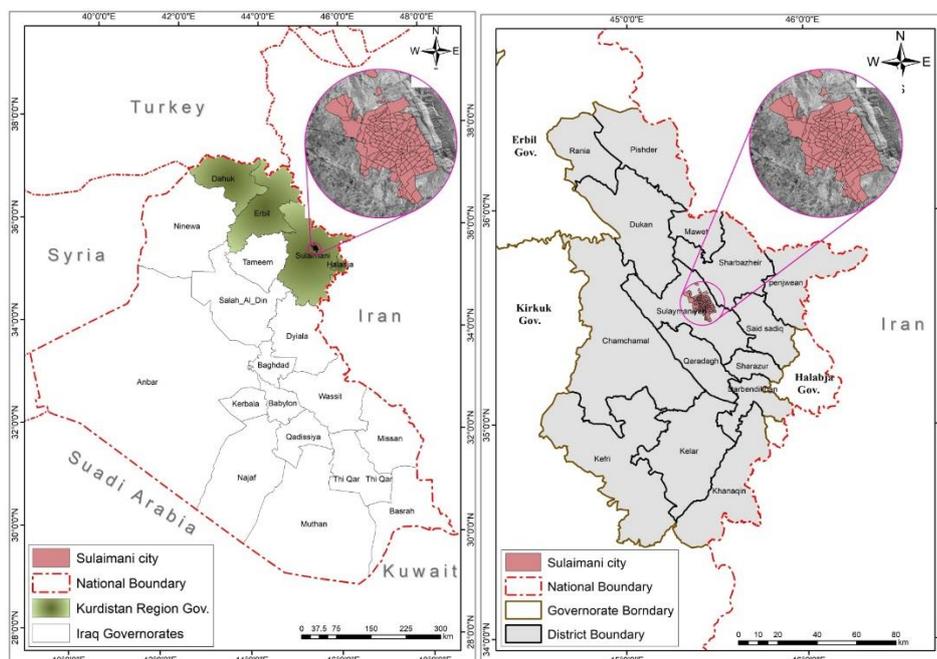


Figure 1: The location of studied city: a) Iraq Country and b) Sulaymaniyah city, Kurdistan Regional Government

## 2.2 Participants and Sample Size Technique

The responders of the research consist of engineers who are currently working either in an office job or a field job in a construction firm. Due to the sample size allocated by considering the engineers in Sulaymaniyah City, a simple random sampling method was carried out (Haji et al., 2021). The data collection took place on December 21st and 31st, 2020, during which 150 engineers filled out the questionnaire, ranging from 22 to 55 years of age and above. Participants' exclusion requirements were to reside in the Kurdistan Region and work either in an office job or a field job. They should work in a category of organization, such as government, private, or another category. Anyone with these credentials was considered eligible to participate in the survey.

## 2.3 Questionnaire Design and Data Collection

The current study aimed to discover how civil engineers from Sulaymaniyah City felt about the lockdown, the predicted effects, and their future perceptions of the civil engineering and construction business. Primary data was collected using the standardized questionnaires created after a review of the literature (Bsisu, 2020; Shibani et al., 2020; Al Amri & Marey-Pérez, 2020). A self-administered online questionnaire was used in this cross-sectional study. The questionnaire was created with Google Forms, a free electronic medium provided by Google, to collect information voluntarily through the designed questionnaire. This survey consisted of 21 closed-ended questions with a suggested filling time of 4-6 minutes. The authors used snowball sampling to distribute the survey link in Sulaymaniyah City.

The questionnaire was divided into four main sections. The first section was the demographics, which was about the general characteristics of the respondents. This type of information allowed us to better understand certain background characteristics of the responders, including their age, gender, field of work, academic background, category of organizations, and role as engineers in the organizations. The second and third sections were about the effect of the COVID-19 pandemic on the work of engineers and the long-term implications of the COVID-19 pandemic on civil engineering and project construction, respectively. The final section was about delays on the construction site due to COVID-19. No identifying information was collected throughout the questionnaire, and the collected data was used solely for statistical analysis. The survey questionnaire was sent to about 170 engineers, 150 of whom responded. The ratio of responding participants was 88.24%. Experts evaluated the draft questionnaire, and the relationships between the items were studied before distributing the questionnaire.

## 2.4 Statistical Analysis Instrument

All statistical analyses were conducted using the Statistical Package for the Social Sciences (SPSS) version 26.0. The software analyzed the percentage and frequency, as well as the cross tabulation, which is a method for quantitatively analyzing the relationship between multiple variables. Cross-tabulation, also known as contingency tables or cross tabs, groups variables to understand the relationship between them (Ahmed et al., 2021).

## 2.5 Ethical Considerations

The study was reviewed and approved by the Tishk International University-Sulaymaniyah Research Center.

### 3. Results and Discussions

#### 3.1 Information about the Participants

In this questionnaire, 150 engineers aged 22 to 55 years old from different construction-related sectors participated. Table 1 shows the demography of the participants. According to the questionnaire, a maximum number of participants were aged between 44 and 55 years old, which was 33.3%, followed by participants who were aged between 33 and 43 years, which was 29.3%. While the minimum number of participants were those aged over 55 years, which was only 12.7%. There was a slight difference between the genders of the participants. 52.7% of the participants were male, while 47.3% of them were female. Participants had different academic backgrounds. 55.3% had bachelor's degrees, which is known to be the maximum number of participants, followed by those who had master's degrees, which was 28.7%, and 12% of participants had Ph.D. degrees, while the remaining 4% had diploma degrees. It can be seen that most civil engineers from the office and site hold B.Sc. degrees.

Table 1: Biography of the survey

Characteristics		Values %
Age	22-32	24.7
	33-43	29.3
	44-55	33.3
	Above 55	12.7
Gender	Male	52.7
	Female	47.3
Academic background	Diploma	4.0
	B.Sc.	55.3
	M.Sc.	28.7
	Ph.D.	12.0

Table 3: The effect of Covid-19 pandemic on civil engineers

Questions	Answers	Frequency (%)	Work field		Category of organization		
			Field job	Office job	Government	Private	Another category
Do you believe working at home will substitute for office work?	Yes	51 (34%)	34	17	12	20	19
	To a degree	70 (46.67%)	34	36	22	31	17
	No	29 (19.34%)	19	10	13	8	8
Do you think applicability will fully implicate social distancing in the workplace?	Yes	47 (31.34%)	35	12	15	21	11
	To a degree	71 (47.34%)	38	33	25	30	16
	No	32 (21.34%)	15	17	7	8	17
Workers will adhere to safety measures and infection control policies.	Agree	48 (32%)	28	20	17	18	13
	To a degree	97 (64.67%)	55	42	27	40	30
	No	5 (3.34%)	4	1	3	1	1
Are you concerned about the safety of fieldwork during the pandemic?	Yes	45 (30%)	32	13	13	17	15
	To a degree	53 (35.34%)	28	25	17	23	13
	No	52 (34.67%)	28	24	17	19	16

### 3.2 Long-Term Implications of the COVID-19 Pandemic on Civil Engineering and Project Construction

Job losses are also a big calamity during the pandemic's worsening situation. During the COVID-19 crisis, millions of people have lost their jobs all around the world. All employees in the project's construction have lost their jobs, and smallest businesses are unable to pay salaries during lockdowns. There is still a scarcity of literature on the epidemic, particularly in project construction. As a result, it's essential to look at the epidemic's impact on the construction industry (Pamidimukkala & Kermanshachi, 2021). Furthermore, construction and engineering projects around the world have been threatened in numerous ways by the COVID-19 pandemic and many projects have been locked (Biswas et al., 2021). The second category is about the long-term implications of the COVID-19 pandemic. This part also consisted of three options, which are (Yes, No, and to a degree) as shown in Table 4.

Participants were asked, "Do they believe some engineers might lose their jobs as a consequence of the COVID-19 pandemic?" 47.34% of the participants agreed to that, mostly having fieldwork, which is 41 engineers out of 150 engineers. Most of the participants who agreed are working in the private sector, which means 27 participants, and 25 of them are working in the government sector, which means only 25 participants disagreed, 16 of them having fieldwork. Again, most of them are in the private sector. The rest of the 54 participants believed it to a degree. Job loss is also a major disaster during the escalating situation of the pandemic. Globally, millions of employees have lost their jobs amid the COVID-19 crisis (Joshi et al., 2020). The present results agreed with the published work by Aziz (2020), which mentioned that COVID-19 impacted several parameters, among them business and staying at home. In addition, Biswas et al. (2021) stated that there has been a financial downturn in the construction industry in almost all countries, which has formed joblessness. The present results agree with Biswas et al. (2021). Additionally, the authors explained that if construction work continues, the economic decline will be reduced and unemployment will be reduced (Biswas et al., 2021).

Sixty-six out of 150 participants (44%) "Believed" that there would be legal consequences for delays in ongoing and planned projects. 66 engineers said yes when 36 were on the job in the field and 30 were in the office. Most of them work in the government sector. Only 22 participants disagreed, while the remaining 62 participants believed that it would affect them to a degree.

Another question that participants answered was "Do your company's contracts include a section for unforeseen events as an acceptable cause for delays?" Most of them, who were among the 59 participants (59.34%), believed it to a degree. 57 of them (38%) agreed to that, of which 32 had fieldwork and 25 had office work. The rest, and the minimum number of those who disagreed, were 34 participants, divided equally by field and office work. The authors found that unexpected events had an effect on the delay of projects.

Another question asked about "Expect a negative financial effect on your sector due to the lockdown". Most of the participants, which was 68 participants (45.34%), are working in the field, and most of them are working in the government sector, which totals 27 participants. Only 37 participants (24.67%) didn't expect to be almost equally divided between field and office work. Most of them are working in the private sector, which means 16 participants. To some extent, the remaining 45 participants (30%) were, to some extent, expected.

The question in this category was whether they were "aware of financial aid available for businesses negatively affected by the COVID-19 pandemic." 47 participants (31.34%) believed they were, while 47 believed they were not. The rest of the 56 participants (37.34%) believed it to a degree. The maximum number of participants who are supposed to be working in the field is 27, while the maximum number of participants who didn't consider working in the office is also 27. Most of the participants who believed they were working in the private sector, which was 20 participants, while most of the participants who didn't believe they were working in the government sector, which was 19 participants.

In conclusion, compared to government sector and office engineers, more field engineers working in the private sector believed that they might lose their jobs as a result of the COVID-19 pandemic. However, most field job engineers in the government sector believed that the legal implications for delays in ongoing and planned projects would happen during this pandemic. As a result, 59 engineers agreed that the company's contract included a section for unforeseen events as an acceptable cause for delays.

Table 4: Long-term implications of the COVID-19 pandemic on civil engineering and project construction

Questions	Answers	Frequency (%)	Work field		Category of organization		
			Field job	Office job	Government	Private	Another category
Do you believe some engineers might lose their jobs as a consequence of the COVID-19 pandemic?	Yes	71 (47.34%)	41	30	25	27	19
	To a degree	54 (36%)	31	23	17	22	15
	No	25 (16.67%)	16	9	5	10	10
Do you think there will be legal implications for delays in ongoing and planned projects?	Yes	66 (44%)	36	30	25	24	17
	To a degree	62 (41.34%)	39	23	19	27	16
	No	22 (14.67%)	13	9	3	8	11
To your knowledge, do the contracts of your company include a section for unforeseen events as an acceptable cause for delays?	Yes	57 (38%)	32	25	20	20	17
	To a degree	59 (39.34%)	39	20	13	29	17
	No	34 (22.67%)	17	17	14	10	10
Do you expect a negative financial effect on your sector due to the lockdown?	Yes	68 (45.34%)	45	23	27	23	18
	To a degree	45 (30%)	25	20	12	20	13
	No	37 (24.67%)	18	19	8	16	13
Are you aware of the availability of financial aid for businesses negatively affected by the COVID-19 pandemic?	Yes	47 (31.34%)	27	20	11	20	16
	To a degree	56 (37.34%)	40	16	17	26	13
	No	47 (31.34%)	20	27	19	13	15

### 3.3 COVID-19 Causes of Delays on Construction Projects

This part discusses the delay due to the COVID-19 pandemic quarantine. According to the survey, the delays were especially in the instructions from the consultants, which then resulted in the delays of materials, equipment, and documents. And of course, these delays cause a lack of productivity in the work (Rehman et al., 2021). In this section, questions have been asked of engineers with five options, which were strongly disagreed, disagreed, neutral, agreed, and strongly agreed, as shown in Table 5.

As a result, most of the engineers (35.34%) chose neutral for the delay of payments to contractors during COVID-19 and 25 engineers in the private sector believed that it was more than the government sector. Also, most engineers considered that during the COVID-19 pandemic, providing the instructions was delayed by consultants, and more of them had field jobs. When the participant asked,

"Do they agree that COVID-19 caused the delay of deliveries such as (i.e., materials, equipment, and documents, etc.)" the maximum responses were agreed to by 56 (37.34%), which mostly work in the field and private sectors. The obtained results agree with the published research by Husien et al. (2021). Additionally, ILO (2021) confirms the yielded results from engineers in the present research. In another question regarding the effect of COVID-19 on delay in revising and approving documents, the optimum response was agreed (58%); this reply came mostly from the field engineers and private sectors.

In another question, when they were asked, "Do they agree that COVID-19 caused the lack of productivity of workers?" Once again, the maximum answer (35.34%) was agreed upon. As usual, most of them were field engineers working in the private sector. The last question in this section was "if they agree that COVID-19 caused the lack of skilled labor?" This time the maximum answer was neutral (38%), but again, most of them were field engineers working in the private sector. Husien et al. (2021) reported that the pandemic increased numerous challenges at the level of the workforce, low or halting productivity, and production time and costs. The current results agree with published work by Husien et al. (2021).

Researchers outlined that commonly, COVID-19 caused delays in payments, instructions by the consultants, supplying materials and instruments, and revising and approving the designs and documents. Additionally, it impacted the productivity of workers, and the lack of skilled labors.

Table 5: COVID-19 reasons for project construction delays

Questions	Answers	Frequency (%)	Work field		Category of organization		
			Field job	Office job	Government	Private	Another category
Do you agree that COVID-19 caused the delay in payments to the contractor?	Strongly disagree	29 (19.34%)	16	13	5	11	13
	Disagree	23 (15.34%)	11	12	9	8	6
	Neutral	53 (35.34%)	38	15	18	25	10
	Agree	29 (19.34%)	18	11	10	6	13
	Strongly agree	16 (10.67%)	5	11	5	9	2
Do you agree that during COVID-19, providing the instructions was delayed by the consultants?	Strongly disagree	11(7.34%)	7	4	3	3	5
	Disagree	34 (22.67%)	17	17	12	11	11
	Neutral	51(34%)	29	22	17	20	14
	Agree	42 (28%)	30	12	11	20	11
	Strongly agree	12 (8%)	5	7	4	5	3
Do you agree that COVID-19 caused the delay of deliveries, (i.e., materials, equipment, and documents, etc.)?	Strongly disagree	14 (9.34%)	9	6	5	6	3
	Disagree	25 (16.67%)	13	12	6	8	11
	Neutral	43 (28.67%)	27	16	15	16	12
	Agree	56 (37.34%)	36	20	19	23	14
	Strongly agree	12 (8%)	4	8	2	6	4
Do you agree that COVID-19 caused a delay in revising and approving documents (i.e., design drawings, shop drawings, and sample materials, etc.)?	Strongly disagree	15 (10%)	11	4	5	5	5
	Disagree	19 (12.67%)	10	9	4	8	7
	Neutral	47 (31.34%)	27	20	16	14	17
	Agree	57 (38%)	36	21	21	24	12
	Strongly agree	12 (8%)	4	8	1	8	3
Do you agree that COVID-19 caused a lack of productivity in workers?	Strongly disagree	8 (5.34%)	4	4	2	4	2
	Disagree	19 (12.67%)	8	11	7	5	7
	Neutral	47 (31.34%)	32	15	18	13	16
	Agree	53(35.34%)	30	23	16	24	13
	Strongly agree	23(15.34%)	14	9	4	13	6
Do you agree that COVID-19 caused a lack of skilled labor?	Strongly disagree	9 (6%)	6	3	3	3	3
	Disagree	13 (8.67%)	4	9	5	6	2
	Neutral	57 (38%)	35	22	21	17	19
	Agree	47 (31.34%)	28	19	14	22	11
	Strongly agree	24 (16%)	14	10	4	11	9

#### 4. Conclusion

It can be concluded that regarding the replacement of work at home with office work, 34% of the engineers agree that these can be replaced together. However, most of those who agree with this view

are among the engineers working in the offices. On the other hand, engineers who working in the field have a greater ability to create social distance in their workplace. In addition, compared to government sector and office engineers, more field engineers working in the private sector believed that they might lose their jobs as a result of the COVID-19 pandemic. Researches outlined that unforeseen events had an influence on the delay of projects. Most field engineers in the government sector believed that the legal implications for delays in ongoing and planned projects would happen during this pandemic. 39.34% of engineers agreed that the company's contract included a section for unforeseen events as an acceptable cause for delays. The authors recognized that generally, COVID-19 caused delays in payments, instructions by the consultants, supplying materials and instruments to the site, and revising and approving the designs and documents. Furthermore, it influenced the productivity of workers, and the lack of skilled labors.

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